DOCUMENT RESUME

ED 141 163 SE 022 685

TITLE Energy for 1970-1990. A Learning Experience for Coastal and Oceanic Awareness Studies, No. 315. [Project COAST].
INSTITUTION Delaware Univ., Newark. Coll. of Education.
SPONS AGENCY Office of Education (DHEW), Washington, D.C.
PUB DATE 74
NOTE 22p.; For related documents, see SE 022 662-687

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Energy; Environment; *Instructional Materials; Natural Resources; *Sciences; *Secondary Grades; *Social Studies; *Teaching Guides; Units of Study
IDENTIFIERS Project COAST

ABSTRACT

This learning experience is designed to be used as a short introduction to energy studies. Included are background material (to be read by students), classroom discussion ideas, classroom activity (teacher's guide and student worksheet); and selected references. (RH)

ENERGY FOR 1970-1990

A Learning Experience for
Coastal and Oceanic
Awareness Studies

Produced by

MARINE ENVIRONMENT CURRICULUM STUDY
MARINE ADVISORY SERVICE
UNIVERSITY OF DELAWARE

and

POPULATION-ENVIRONMENT CURRICULUM STUDY
COLLEGE OF EDUCATION
UNIVERSITY OF DELAWARE

as part of a

PLAN FOR ENVIRONMENTAL EDUCATION

Fall 1974

Please send evaluations

of learning experiences

to

Dr. Robert W. Stegner, Director

COAST Project

310 Willard Hall Education Building

University of Delaware

Newark, Delaware 19711

Supported in part by

OFFICE OF COASTAL ZONE MANAGEMENT (NOAA)

DELAWARE SEA GRANT COLLEGE PROGRAM (NOAA)

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DUPONT EDUCATIONAL AID COMMITTEE

TITLE: ENERGY FOR 197-1990

* CONCEPT: IV.C.3.

IV. Cultural evolution led to dominance of the environment.

C. The growth of science and technology increased man's use of natural resources.

3. TECHNOLOGICAL ENTERPRISES INCREASE MAN'S CONTROL OF THE ENVIRONMENT.

** MARINE CONCEPT: 4.2

4. Man is part of the marine ecosystem.

4.2 MAN'S ACTIVITIES MAY DEPLETE AND DEGRADE MARINE ECOSYSTEMS.

(This learning experience is also pertinent to MINERAL RESOURCES ARE NON-RENEWABLE, Concept V.C.2.a.)

GRADE LEVEL: 9

SUBJECT: Science, Social Studies

CLASS PERIOD: 1

AUTHOR: Wagner

Note to Teacher:

This learning experience is designed to be used as a short introduction to energy studies. You might wish to show one of the films cited below as a supplement to this learning experience.

"A Thousand Suns"
Arthur Barr Productions, Inc.
P.O. Box 7-C
1029 Allen Ave.
Pasadena, CA 91104

"Energy to Burn"
BFA Educational Media
2211 Michigan Ave.
Santa Monica, CA 90404

CONTENTS

* From A Conceptual Scheme for Population-Environment Studies, 1973. $2.50.

** From Marine Environment Proposed Conceptual Scheme, 1973. No charge.

Both conceptual schemes are available from Robert W. Stegner, Population-Environment Curriculum Study, 310 Willard Hall, University of Delaware, Newark, DE 19711

I. BACKGROUND

Energy is the building block of modern civilization. The United States has always had an abundant supply of energy, almost to the point of being spoiled. Figure 1 (p. 3) shows the energy consumption and living standards of selected countries with the USA ranking first. In early 1974 this country suffered its first real energy crisis which was triggered by the sharp reduction in imported oil from the Middle East. During this time there was a shortage of fuel to heat our homes and schools; we had to wait in long lines to buy gasoline on odd or even numbered days; and we switched to daylight-saving time to use the energy of the sun more advantageously. However, Figure 2 (p. 4) shows that the total demand for coal, gas, oil, and hydro-nuclear energy has been exceeding our domestic supply since 1970 and that this situation is expected to become much worse by 1990. We have heard that the government should have used more controls to avoid this crisis, that industry should have had more social conscience rather than a pure profit motive, and that environmentalists should have been more realistic in their protection of our wildlife and their fight against air pollution. These arguments vary depending on the person to whom you are listening. We must have the facts so that we can evaluate the situation for ourselves and plan for the future.

First let us consider why the total demand for coal, gas, oil, hydro-electric, and nuclear energy has been exceeding our total domestic supply. The overall increase in population accounts for only one-seventh of the total increase in demand for energy. Other reasons for the increase in demand include increases in air and automobile travel, an increase in the use of electricity, and the diversion of oil supplies to the production of plastics. Most plastic products actually come from petroleum products. What objects are now made of plastic that were not made of plastic five years ago? (Clothes, automotive parts, furniture, etc.) What appliances in your home use the most electricity, and what electrical appliances have you added to your household in the past five years?

Next let's consider how energy is used today and what can be done to improve our energy resources. Figures 3 and 4 (pp. 5 and 7) show the total energy flow in the United States in 1970. Figures 3a and 3b are actually simplified pie diagrams of the first two parts of Figure 4. The major sources of energy today are oil, gas, and coal with a minor input by nuclear, hydro-electric, and geothermal processes. Note the small percentage (10%) of imported oil in 1970 in Figure 3a (p. 6). Figure 3b shows the end uses of energy. This figure shows that 21 percent of all our energy sources is used to generate electricity, 22 percent is used to heat residential and commercial buildings, and 23 percent is used for our numerous means of transportation. The largest segment (28%) of our energy sources is used by industry for operating our factories and producing goods, while the smallest segment (6%) is for plastic material and other non-energy uses.

In addition to showing the total energy flow in the United States in 1970, Figures 3 and 4 (pp. 5 and 7) also show whether the energy is ultimately used productively or wasted. Note that 21% of the total energy flow goes to electrical energy production but two-thirds of this is immediately lost in conversion. The useful electrical energy produced is then evenly split between residential/commercial use and industrial use. Of the end uses in the energy flow pattern, transportation uses an amount almost equal to the residential and

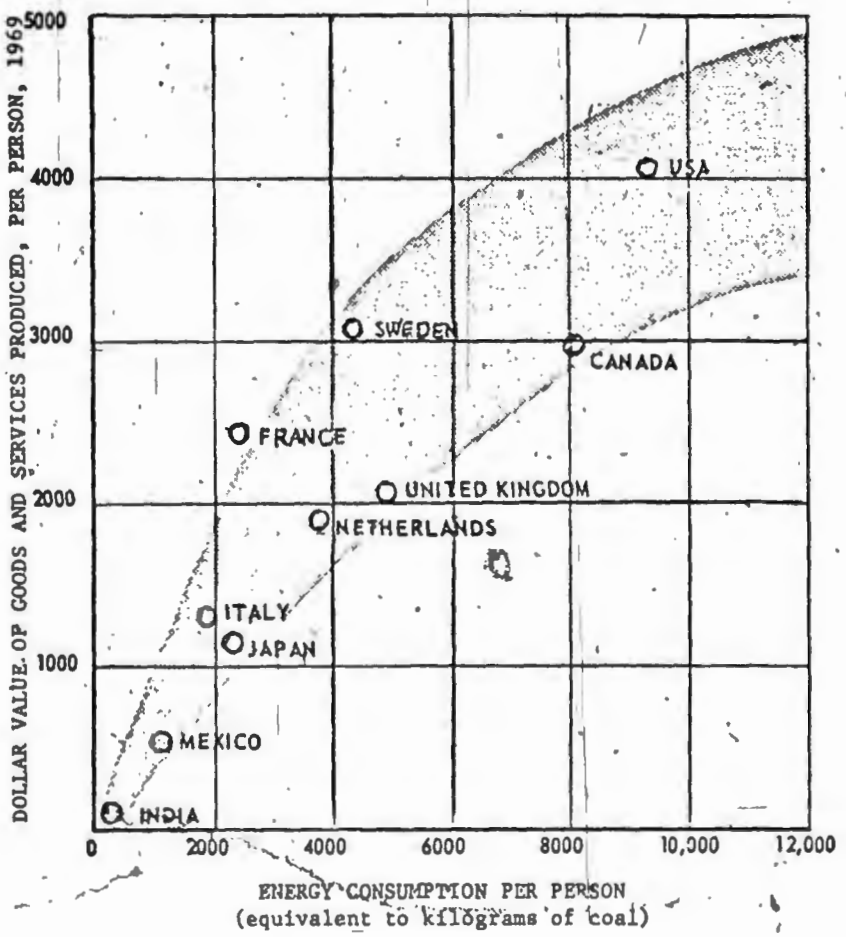
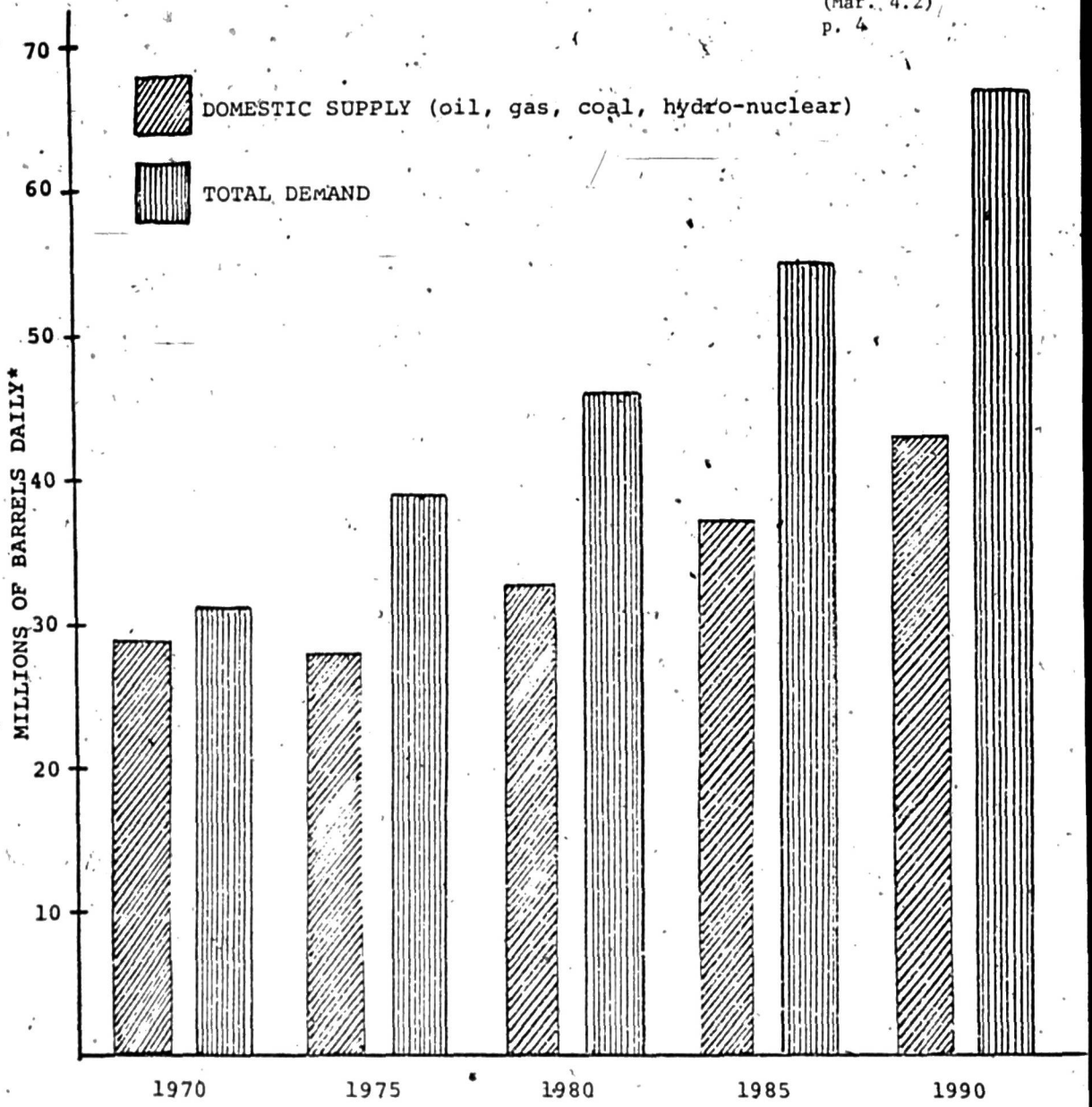


FIGURE 1

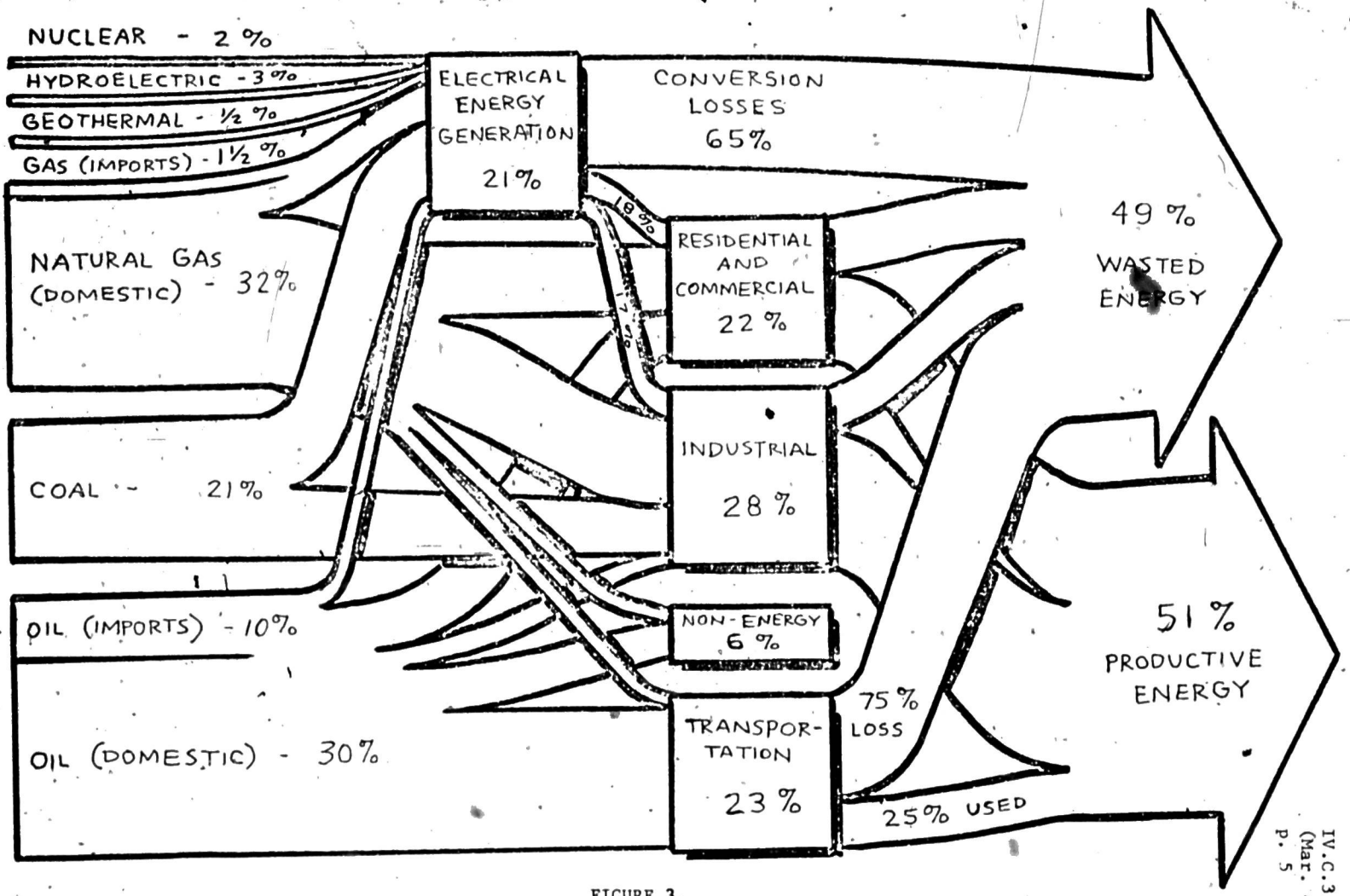
Source: McDermott. 1973. The Environmental Impact of Electrical Power Generation: Nuclear and Fossil.



*crude oil equivalent

FIGURE 2: THE U.S. ENERGY GAP, 1970-1990

Adapted from: Shell Oil Company. 1973. The National Energy Outlook.



IV.C.3. (Mar. 4.2) p. 5

FIGURE 3

1970 ENERGY FLOW DIAGRAM

Source: Joint Committee on Atomic Energy. 1973. Understanding the National Energy Dilemma.

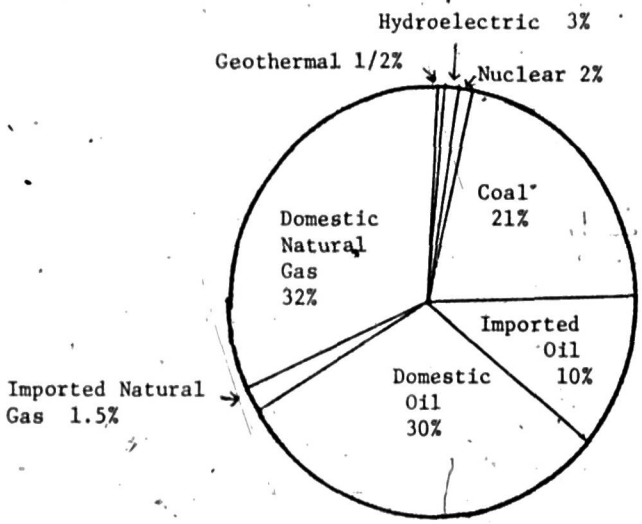


FIGURE 3a: DISTRIBUTION OF ENERGY SOURCES IN 1970

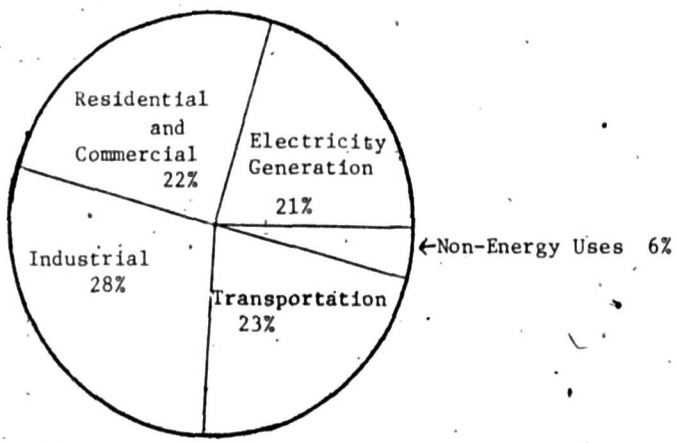


FIGURE 3b: DISTRIBUTION OF END USES OF ENERGY SOURCES

Source: Joint Committee on Atomic Energy 1973. Understanding the National Energy Dilemma

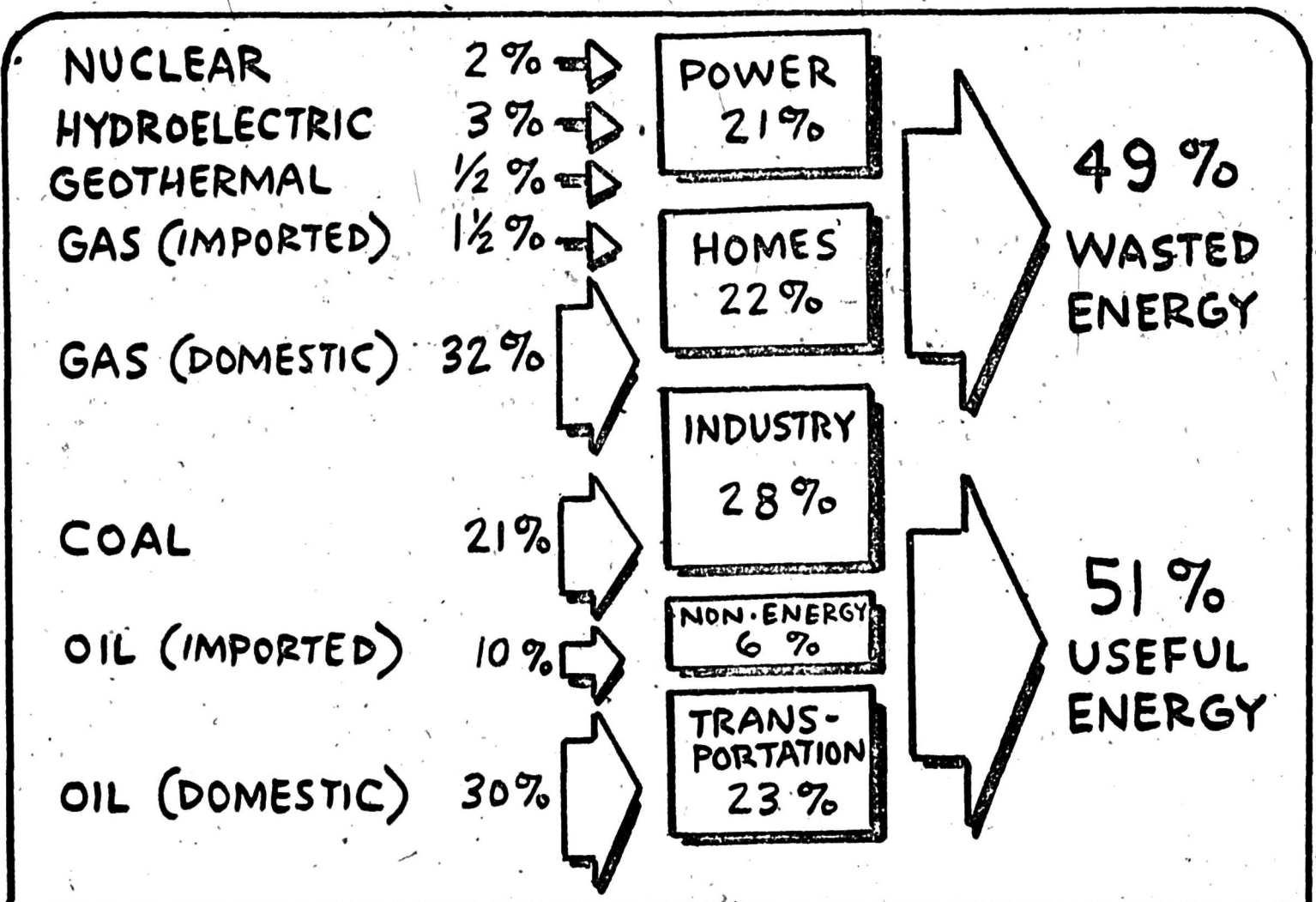


FIGURE 4: 1970 ENERGY FLOW DIAGRAM

Source: Joint Committee on Atomic Energy. 1973. Understanding the National Energy Dilemma.

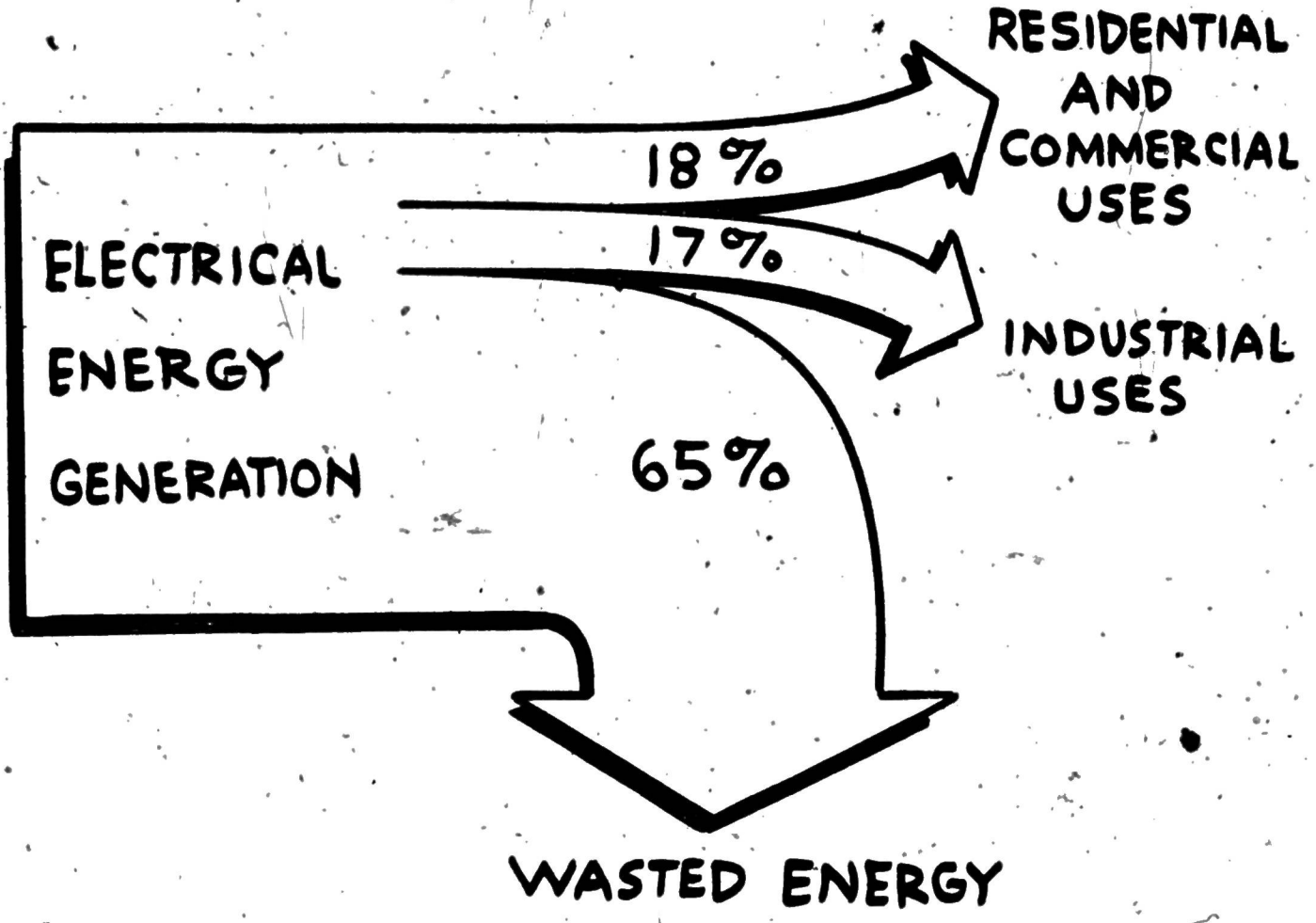


FIGURE 4a

Source: Joint Committee on Atomic Energy. 1973. Understanding the National Energy Dilemma.

IV.C.3. (Mar. 4.2) p. 8

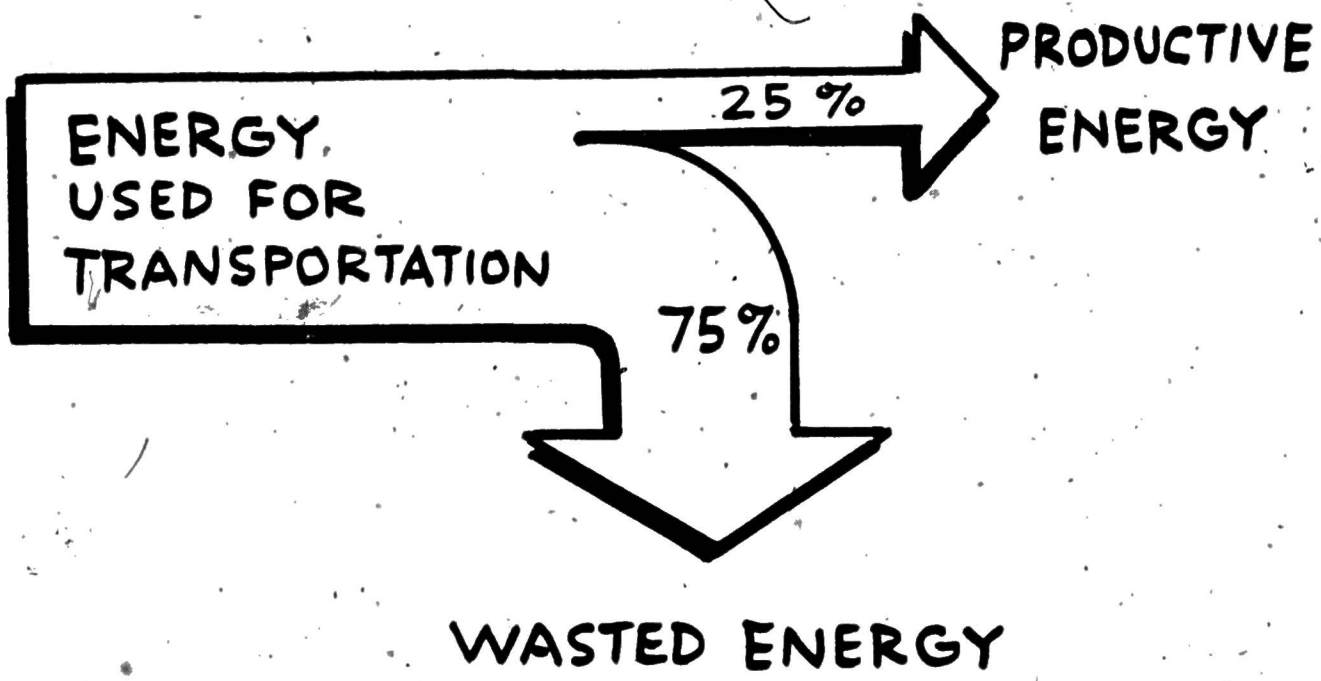


FIGURE 4b
Source: Joint Committee on Atomic Energy. 1973. Understanding the National Energy Dilemma

commercial block, but only 25% of the energy is actually used. The remaining 75 percent is wasted in high-grade fuel production and engine inefficiencies. Note also that six percent of the total energy flow went to non-energy use, which includes the production of synthetic materials, plastics, and chemicals. The energy flow pattern for 1970 does not tell the complete story. At this time (1970) environmental controls had restricted the use of coal in favor of "cleaner" fuels--gas and low-sulfur oil. Social restrictions at this time had also retarded the development of nuclear power. People did not want a nuclear power plant built near their homes because they were afraid of nuclear radiation leaks, possible nuclear accidents, and thermal pollution. Also unforeseen was the increase in the price of a barrel of imported oil. It is now economically feasible to exploit domestic resources that were previously neglected.

As an immediate relief from the energy shortage we could use coal, which is abundant in the United States. The effects of mining and burning coal, however, are environmentally disastrous because of its high sulfur content and present mining practices. When high-sulfur coal is burned, sulfur dioxide is released which mixes with air to form an acid. This acid has a detrimental effect on vegetation and human health. Strip-mining, the most commonly used method of obtaining coal, destroys the topsoil, pollutes the rivers and streams, and leaves tremendous holes in the earth that upset the delicate balance of nature. These problems will have to be overcome.

Another possible source for immediate relief would be improvement of techniques to recover known oil resources. Presently, only 30 percent of the known oil in the ground can be recovered. Seventy percent of the oil must be abandoned since we do not have the technology to remove it. A source of energy that has long been neglected by the United States is shale oil. Oil shale is a rock rich in oil that can be removed by heating. There are large deposits of oil shale in the western United States, but again the technology must be developed. Also, new deposits of oil, such as the one at the Alaskan North Slope, might be found. One area that is being explored is off the Atlantic Coast.

In the long term, nuclear and solar resources can be developed. Presently there are enough known uranium sources to last until the year 4000. The sun provides the earth with enough energy each day to meet the world's needs for a year, if this energy could be captured. Other neglected sources of energy, such as wind, geothermal, and tidal energy, can be exploited and hydrogen, the cleanest form of fuel, can be given more study.

II. CLASSROOM DISCUSSION

A. There is only a finite, or fixed, amount of energy available in the world. Referring to Figure 1, p. 3, compare the energy consumed by each individual in a country to the amount of goods and services produced per person in that country. Compare the energy consumed with the goods produced for the different countries.

(The general trend is for a country which produces a high value of goods and services, such as the United States, to have a high rate of energy consumption per person. Also, a country with a low rate of energy consumption, such as Mexico, produces a low value of goods and services per person. Some countries utilize energy more efficiently than others due to their climate and other factors. For example, Italy produces a higher value of goods and services per person than does Japan, but Italy has a lower rate of energy consumption per person than Japan does.)

B. Refer to Figure 2, p. 4. The total demand for energy in the United States is predicted to increase each year, but the domestic supply of energy is not predicted to keep up with the total demand. Why?

(Total demand has been increasing faster than we have been able to develop our resources. The demand provides the motivation to develope the supply, but it takes time to build nuclear plants, find new oil reservoirs, and develop technology to utilize coal resources without environmental pollution. We have an abundance of coal but it has a high sulfur content, and strip-mining, which is environmentally disastrous, has been the quickest, safest, and cheapest method to retrieve it from the ground.)

C. Figures 3, 3a, 3b, 4, 4a, and 4b, pp. 5-9, show the flow of energy from its sources to its end uses and how much of the energy is actually used.

Points to notice are:

1. A small amount of nuclear, hydroelectric, and geothermal energy is available.
2. Approximately half the total source energy is wasted.
3. A large amount of energy is lost in converting source energy to electrical energy.
4. When using a source energy to produce another form of energy, such as electrical energy or mechanical energy, there is low efficiency.
5. A large fraction of energy used in tranportation is wasted.

III. CLASSROOM ACTIVITY--TEACHER'S GUIDE

A. On page 14 is a list of most electrical items used in a modern home. Make a list of all the electrical appliances and equipment used in your home and estimate the annual kilowatt-hour consumption for your family. If you divide this total consumption by the number of people in your family, you will have your annual kilowatt-hour consumption per person.

(2800 kilowatt-hours is an annual average figure per person in a family of four.)

B. If one KWH costs 5 cents, what is your monthly electric bill? Divide your annual family kilowatt-hour consumption by 12 months and multiply it by $.05.

(The figure should be approximately $50 a month. If the figure is lower, remember that not all equipment in the home is electric; some may use gas.)

C. Which appliances use more electricity--appliances that heat and cool, or appliances that do mechanical work?

(More electricity is needed to heat and cool. Note the difference between the washer and dryer. Note the consumption of the hot water heater, air conditioner, range, and refrigerator.)

III. CLASSROOM ACTIVITY--STUDENT WORKSHEET

A. Attached is a list of most electrical items used in a modern home. Make a list of all the electrical appliances and equipment which are used in your home and estimate the annual kilowatt/hour (KWH) consumption for your family. If you divide this total consumption by the number of people in your family, you will have your annual kilowatt hour consumption per person.

B. If one KWH costs 5 cents, what is your monthly electric bill?

Divide your annual family kilowatt hour consumption by 12 months and multiply by $.05.

C. Which appliances use more electricity--appliances that heat and cool, or appliances that do mechanical work?

ELECTRIC APPLIANCES	ESTIMATED YEARLY KILOWATT HOUR CONSUMPTION/FAMILY--1969
Air conditioner (Window)	1389
Bed covering	147
Broiler	100
Carving knife	8
Clock	17
Clothes dryer	993
Coffeemaker	106
Deep fat fryer	83
Dishwasher	363
Fan, circulating	43
Fan, furnace	394
Fan, window	170
Food blender	15
Food freezer (15 cu. ft.)	1195
Food freezer, (frostless 15 cu. ft.)	1761
Food mixer	13
Frying pan	186
Hair dryer	14
Heat lamp	13
Heater (radiant)	176
Heating pad	10
Hot plate	90
Humidifier	163
Iron	144
Oil burner or stoker	410
Radio	86
Radio-phonograph	109
Range	1175
Refrigerator-freezer (14 cu. ft.)	1137
Refrigerator-freezer (frostless, 14 cu. ft.)	1829
Roaster	205
Sewing machine	11
Shaver	18
Television (black & white)	362
Television (color)	502
Toaster	39
Toothbrush	5
Vacuum cleaner	46
Waffle iron	22
Washing machine, automatic	103
Water heater, standard	4219
Water pump	231

Source: U.S. Senate Committee on Interior and Insular Affairs. 1972. Conservation of Energy.

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